http://www.epa.gov/rpdweb00/tenorm/uranium.html
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Radiation Protection

Uranium Mining Wastes

The mining of uranium ores by underground and by surface methods produces large and small amounts of bulk waste material:

- excavated top soil
- overburden that contains only traces of ore
- weakly uranium-enriched waste rock,
- subgrade ores
- evaporation pond sludges and scales.

These materials typically contain radionuclides of radium, uranium, and thorium. EPA has completed detailed technical reports from studies on uranium mining TENORM wastes as well as developed a database of mine locations.

Materials	Radiation Level [pCi/g]		
	low	average	high
Uranium Mining Overburden			low
Uranium In-Situ Leachate Evaporation Pond	3	30	low hundreds
Solids	300		3000

The Radiation in TENORM Summary Table provides a range of reported concentrations, and average concentration measurements of NORM associated with various waste types and materials.

Uranium mining wastes comprise several types of waste:

- overburden (soil and rock that is covering a deposit of ore, such as uranium. It usually contains at least trace amounts of the ore plus radioactive decay products)
- unreclaimed, subeconomic ores (ores that have too little uranium to be profitable, called "protores)
- "barren" rock (rock containing no ore)

- drill cuttings.

Both surface and underground mining of uranium ores produce large amounts of this radioactive waste material. It is classified as NORM (Naturally Occurring Radioactive Materials) or TENORM (Technologically Enhanced Naturally Occurring Radioactive Materials).

On this page:

What is the History of Uranium Mining in the U.S.?


Uranium Ore

The uranium mining industry began in the 1940s primarily to produce uranium for weapons and later for nuclear fuel. Although there are about 4,000 mines with documented production, a database compiled by EPA, with information provided by other federal, state, and tribal agencies, includes 15,000 mine locations with uranium occurrence in 14 western states. Most of those locations are found in Colorado , Utah, New Mexico, Arizona, and Wyoming, with about 75% of those on federal and tribal lands. The majority of these sites were conventional (open pit and underground) mines.

With the drop in market price of uranium beginning in the 1980's U.S. producers turned to in-situ leaching operations to extract uranium from ore. (In-situ leaching involves injecting solutions that will dissolve the uranium from the ore directly into the ground and then pumping out the uranium containing solution). By 2004, according to the Department of Energy's Energy Information Administration, there were only six uranium mines operating in the U.S. and half of those were in-situ operations. However, the number of operating mines of all kinds may increase as a result of higher world uranium prices and decreasing supply in the U.S.

- U.S. Uranium Mine Production and Number of Mines and Sources
- U.S. Energy Information Administration
  official energy statistics from the U.S. Government

Who regulates these wastes?

Because U.S. laws do not classify mine overburden as a radioactive waste, its placement in radioactive waste disposal facilities is not required. The Atomic Energy Act does not require controls on uranium mining overburden and neither the Nuclear Regulatory Commission nor the Department of Energy(DOE) regulates the disposal of conventional (open pit and underground) mining wastes. However, EPA has authority, under a variety of legal statutes, to protect the public and the environment from exposures to both the hazardous and toxic

characteristics of these wastes, which are classified as TENORM.

EPA frequently extends this authority to individual states, or federal land management agencies, which regulate the environmental impacts under clean water and clean air laws. These organizations also have a general authority to protect people and the environment from the adverse effects of mining activities.

In contrast, the uranium produced from the mined ore is directly regulated. Its possession, use, transport, etc. are regulated by both the NRC and its Agreement States. Regulation begins when the uranium is separated from the surrounding rock (beneficiated) or brought into the milling circuit for refining into uranium yellowcake. The regulations also cover production from in-situ leaching operations.

How much of this waste was produced in the U.S.?

There is no exact total of these wastes. However we do have estimates based on U.S. Geological Survey data. According to USGS estimates, the approximately 4,000 open pit and underground mines in their database generate about three billion metric tons. (The volume of waste (including overburden) produced by open-pit mining is a approximately 45 times greater than wastes produced from underground mining.) Given the larger number of mine locations identified by EPA, the amount of waste rock is likely to be higher.

What is EPA doing about these wastes?

EPA is currently studying the extent and nature of the TENORM problem in the form of mining wastes and its potential health effects. To date, we have developed technical reports on mining wastes and a database of mining locations with uranium containing wastes in the 14 western states:

- Technical Reports
  - Reports to Congress
  - National Academies of Science review of TENORM guidance and EPA response
  - TENORM from Uranium Mining
- Mine Location Database

Technical Reports

Reports to Congress

Three earlier EPA reports summarized the state of knowledge at the time about uranium mining, its wastes, and potential hazards:

Report to Congress on the Potential Health and Environmental Hazards of Uranium Mine Wastes, 1983
This study provided an important overview of the characteristics and generation of uranium mining TENORM wastes during a period when the uranium mining industry was

still near its production peak. Although out of print, EPA has prepared an Adobe Acrobat (pdf file) copy of the report which is available upon request from radiation

Report to Congress on Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale, [EPA 530-SW-85-033] December, 1985
This study provided additional risk information and characterization of uranium mining waste. This report is available upon request from EPA's Radiation Protection Program (radiation.questions@epa.gov).

Extraction and Beneficiation of Ores and Minerals: Uranium (PDF) (139pp, 490Kb [about pdf format]) [EPA 530-r-94-032] January, 1995
EPA issued this technical resource document as an update to the 1985 report to provide a means to evaluate whether wastes were exempt from or subject to regulation under the Resource Conservation and Recovery Act.

National Academies of Science Review of EPA's TENORM Guidance and EPA Response

In 1999, EPA requested a review of its guidance for management of TENORM wastes by the National Academy of Sciences. Its report is available from the National Academies Press:

Evaluation of Guidelines for Exposures to Technologically Enhanced Naturally Occurring Radioactive Materials EXIT Disclaimer

EPA's response to the report is available as a Report to Congress:

Evaluation of EPA's Guidelines for Technologically Enhanced Naturally Occurring Radioactive Materials (TENORM) Report to Congress (PDF) (22pp, 393.7 Kb [about pdf format]) [EPA 402-R-00-01] June, 2000

TENORM from Uranium Mining Reports

Following the NAS report, EPA's response to it, and discussions with EPA's Science Advisory Board, EPA decided that the current hazards associated with uranium mining TENORM warranted additional study.

In 2008, EPA updated and re-released a two-volume technical report on uranium mining TENORM wastes, *Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining,* Volumes 1 and 2:

- *Volume 1; Mining and Reclamation Background* provides background information on the occurrence, mining, and reclamation of uranium mines.
- Volume 2: *Investigation of Potential Health, Geographic, and Environmental Issues of Abandoned Uranium Mines* provides a general scoping evaluation of potential radiogenic cancer and environmental risks posed by abandoned uranium mines.

Mine Location Database

EPA worked with the multi-agency Colorado Plateau Data Coordination Group Steering Committee to develop a geographic information database on uranium mines and mills. (The Agency also coordinated this effort with federal, state, and tribal agencies in other parts of the western U.S.)

The database identifies and shows the location of active and inactive uranium mines and mills, as well as mines which principally produced other minerals, but were known to have uranium in the ore. The database covers mine locations in fourteen western states. It also contains other information about the sites. Originally compiled as an important component of the uranium mining technical reports currently being developed, the database was reviewed and checked for its quality to eliminate duplicate and erroneous sites, and subjected to EPA's scientific peer review process.

The database and descriptive materials about its content are now available.

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